REEF RESCUE: THE RACE TO SAVE THE WORLD'S CORAL REEFS

Time

1.5-2.5 hours (Allow additional time for research. Can be divided over numerous learning blocks.)

Overview

Why are coral reefs important and how do the actions of Canadians impact reefs? What is causing the bleaching and destruction of the world's coral reefs and what is being done to help these essential structures survive?

This lesson is best completed after watching the *Reef Rescue* documentary and completing the associated Discussion Questions activity.

Subject/Topic

Science, social studies, climate change, marine ecosystems

Grade Level

Grades 7-12

Learning Goals

Students will:

- Understand the role of coral in oceans.
- Identify the causes of coral bleaching.
- Explore the importance of coral reefs and species that rely on them.
- Appreciate the diversity of coral reefs.
- Develop a story of coral through images.
- Make use of an online interactive tool to further their understanding of themes presented in *Reef Rescue*.
- Develop and present a project that more deeply explores a topic raised in *Reef Rescue*.

Lesson Description

Minds on

Students will watch a recorded video of the Cayman Reef and think about all of the species that rely on coral reefs worldwide.

Action

In group discussions, students will learn about corals and their ecological and oceanic importance. Using the online interactive tool to explore themes presented in the *Reef Rescue* documentary, students will work in groups to interpret images relating to coral reefs and will create a photo essay telling a story of coral. Next, students will individually or in small groups spend more time exploring the interactive tool to discover a topic that interests them. They will work to create a project that dives deep into this topic and present it.

Conclusion

Students will present their research projects to classmates. Students will reflect on what they have learned and how they can contribute to the worldwide effort to save coral reefs.

Lesson Implementation

Minds on

After students have watched the *Reef Rescue* documentary, engage them in further understanding the biodiversity and importance of these systems by watching the *Explore - Oceans* live camera highlights of the Cayman Reef. This video is of a lagoon reef system and shows an area where small cleaner wrasse and shrimp clean larger fish, which is also known as a cleaning station. After a few minutes, pause the video and ask students to count and, if possible, identify species. Remind them to include not only fish, but coral species as well. How many fish and different species did they count? How many coral species could they see? Ask students to think about who might rely on these fish species and what would happen at a regional, local, and global scale if coral reefs disappeared.

Action

To help students understand why it's important for our society to address coral bleaching, they should first understand what corals are and their importance to humans and marine species. Take a poll asking students whether they think corals are plants, minerals or animals. Explain that corals are in fact animals, and they are truly spectacular; they can build the largest biological structures on Earth! Corals are animals because they cannot make their own food, they need to get it from their environment, which they do using very small tentacles to trap food.

Show students a generic image of coral. Ask them how many organisms they see. Explain that this structure is actually hundreds to thousands of polyps, which is what we call these tiny coral creatures. To help students understand how corals and coral reefs form, and their importance, show students this four-minute *National Geographic* video on corals. Discuss with students new things that they learned

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Materials Needed

- Computers or electronic devices
- *Reef Rescue** documentary (to watch beforehand)
- Discussion Questions activity (to complete beforehand)
- Reef Rescue interactive tool
- Story of Coral cards (1 set per group)
- KWL chart (1 per student)
- Writing utensils

**Reef Rescue* can be screened on CBC Gem until January 2025. After that date, please contact info@cangeoeducation.ca for access.

Connection to the Canadian Geography Framework

Concepts of Geographic Thinking

- Spatial significance
- Patterns and trends
- Interrelationships
- Geographic perspective

Inquiry Process

- Formulate questions
- Gather and organize
- Interpret and analyze
- Evaluate and draw conclusions
- Communicate

Geospatial Skills

- Spatial representations
- Technology

about coral and what they already knew or suspected. Ask what other questions they have about the life and importance of coral.

Discuss with students why they think coral reefs are important to different species on the planet, including humans. In what ways do species rely on coral reefs? Some possible reasons include:

- More than half a billion people around the world depend on coral reefs for the following reasons:
  - ▷ Fishing: There are around 3 billion people worldwide for whom fish is the main source of animal protein, including species that spend part, if not all, of their lives on coral reefs. The fish, lobsters and other species that live on reefs are also a vital source of income for communities all over the world.
  - ▷ Tourism: Coral reefs help to bring tourists to areas by offering visually appealing areas for diving and tours.
  - ▷ Coastal protection from storms: Coral reefs help to protect coastal areas by reducing wave energy by up to 97 per cent and wave height by more than 70 per cent.
  - ▷ Potential sources of medicine: Certain plant and animal species that are found in coral reefs contain chemical compounds that have been used in medicine for treating various diseases, such as cancers and heart disease.
- One quarter of marine life will visit coral reefs at least once in their lifetime for numerous reasons:
  - ▷ Habitat and breeding: Species migrate to coral reefs and their surrounding areas throughout the year. The humpback whale migrates about 4,800 kilometres every year from polar regions in the summer to warmer tropical waters (like Hawaii) in the winter to breed and raise their young. Coral reefs play an important role in these marine ecosystems on which whales rely.
  - ▷ As the ocean's nursery: Coral reefs serve as a safe place for many species to grow.
  - ▷ Food: Many species feed off of organisms found in and around the reef, and they in turn may become food for other species in the marine food chain.

Next, ask students about the ways in which they think they have an impact on coral reefs. Record answers on the board and discuss their ideas. Some possible answers include:

- We contribute to climate change through our daily habits and actions (e.g., driving a car, using energy inefficiently at home, eating food that has to travel from far away), which causes coral bleaching.
- Tourism: When we go on vacation, we can negatively affect coral reef ecosystems through our use of sunscreen (certain types have chemicals harmful for marine species), irresponsible diving practises, and taking or buying corals as gifts.

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- Pollution: Precipitation can cause pollutants (e.g., agricultural runoff) to get into waterways, which flow to the ocean. Other types of pollution can include oil spills and plastic debris.
- Fishing industry: Some of the seafood we buy may come from areas where certain fishing methods damage the environment, such as with trawlers that drag fishing nets across the bottom of the ocean.

Explain to students that although we have names for the various ocean basins, such as the Atlantic and Pacific, there is actually only one connected global ocean. What happens in one area of the ocean is not isolated and has an impact thousands of kilometres away.

Students now have a bit of background knowledge of coral reefs, their importance, and how scientists are trying to save them. Explain that they will now have the chance to dive deeper into the locations featured in the documentary, learning more about the species that rely on coral reefs, the science behind coral reefs and the approaches to help them adapt, the technology being used to make that science possible, and how people worldwide are connected to and rely on coral reefs.

Part 1: Photo Essay - The Story of Coral

Divide students into small groups, with each group having one device and one set of The Story of Coral image cards (this can also be done individually). Let students know that their task will be to tell the story of coral using only these images. Alternatively, students can find suitable images online. It is up to them to interpret the images and decide in what order they should be. Remind students that there is no right answer; each story may be different depending on what message they would like to get across. For example, some students may start with the image of healthy coral, or some students may end with that image.

To help them, instruct students to use the Reef Rescue interactive tool to explore the four locations featured in the documentary: Hawaii and Florida in the United States, Australia, and Kiritimati Island in the Republic of Kiribati. Students will be able to dive deeper into each of these four locations while learning about the science and technology behind attempts to save coral, how coral reefs are an essential part of marine ecosystems, how humans are affecting reefs through climate change, and how coral reefs are necessary for human survival. Students can also learn more about the scientists highlighted at each location in the documentary, learning about their research and careers. Using what they have learned through the interactive tool, students should collaborate with their group members (if in groups), decide what story they would like to tell, and how they should order their images. Allow students time to present their photo essay and tell their story of coral.

Part 2: Research Project

Now that students have been introduced to reef ecosystems, the connection between climate change and coral bleaching, and the different approaches to saving coral reefs, students can, individually or in small groups, choose a topic that interests them and research it further. Students should use the Reef Rescue interactive tool to

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explore different subjects relating to coral reefs, their destruction, the efforts to save them, and careers related to coral reef preservation. To help students, have them fill out the KWL chart while exploring the interactive tool. Students can then complete additional research to help develop their project. Some options include:

- A presentation showcasing a species that relies on coral reefs
- An infographic explaining the science of assisted evolution, labs attempting it and other methods scientists are discovering to assist evolution
- A research paper outlining the technologies of a laboratory featured in the documentary
- A video showing the political, economic and demographic situations of reef locations
- A public service announcement (PSA) video about what Canadians can do to help reefs
- A PowerPoint of the science behind coral bleaching
- An art project showcasing the diversity of reefs
- A fictional story of what the world would look like without reefs
- A profile of the careers of marine biologists
- An interview with a scientist working in the field of corals
- A mapping project demonstrating reef locations and sizes over decades
- A drama performance showcasing the causes of the destruction of coral reefs
- A debate between two students about the ethics of assisted evolution*
- A Google Earth Voyager project visiting unique reef locations and the communities that live there
- A project tracking a species from a coral reef to where it travels throughout the world
- A fictional story set in deep-sea coral reefs exploring this unique habitat
- A mapping project showcasing where and what type of corals can be found along Canada's coastline
- An investigative report into why some corals survive bleaching and others do not

*Note that there is a difference between assisted evolution and genetic modification. Assisted evolution is a process where scientists work with coral's natural ability to adapt to changing conditions, to do what evolution would do but in a much shorter time span. With a goal of fostering resilience, researchers condition or exercise coral by exposing it to heat, by breeding corals, or forcing corals to switch to a heat-tolerant algal partner. Genetic engineering uses DNA technology to alter the genetic make-up of an organism. Altering the genetics of coral could be done under the umbrella of assisted evolution.

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Have a discussion with students around research and how to turn that into a good research project. Remind students about defining their thesis and topic, organizing their ideas and arguments, how to find reputable sources, how to avoid plagiarism, how to cite sources and what a bibliography looks like. For help in starting their research, encourage students to use a graphic organizer. Students may require multiple periods to complete their projects.

Conclusion and Consolidation

Have students present their completed projects. Have a question-and-answer period and take note of any unanswered questions that can be explored later.

Ask students to complete a reflection piece where they think about what they've learned over the course of their project and what action they have been inspired to take. This can be a written piece or done in pairs or small groups.

Extend your geographical thinking

- Learn about the scientists featured in the documentary and their individual research and labs:
  - The late Ruth Gates - Gates Coral Lab
  - Madeleine van Oppen - Australian Institute of Marine Science
  - Andrew Baker - Coral Reef Futures Lab
  - Greg Asner - Asner Lab Global Airborne Observatory
  - Julie Baum - The Baum Lab
- Investigate how people who rely on reefs are adapting and how these people are contributing their knowledge to the fight to save reefs.
- Compare the bleaching of coral reefs and the impact on local communities that rely on them to the disappearance of sea ice and the impact on Indigenous Peoples in Canada.
- Examine the economic contribution of coral reefs to communities and the world.
- Invite scientists to speak virtually with your school about coral reefs.
- Get students to explore coral reefs virtually with the 180° or 360° VR videos online, such as this video of the Great Barrier Reef.

Modifications

The research project can be adapted in the following ways, depending on the student:

- The requirements, depth, and length of project
- The form of the research project and the way it is presented
- The amount of time to complete project

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Extension opportunity:

- Raise awareness about coral bleaching and ways that Canadians can help by running an awareness campaign in your school or community.

Assessment Opportunities

- Students' answers while watching the Cayman Reef feed can be assessed for knowledge and comprehension.
- Observational notes can be taken of students' responses during the Story of Coral presentations.
- Opportunities for feedback (self, peer and teacher) can be provided throughout the research project.
- Students' projects can be assessed.
- Students' reflections can be assessed and used to guide next steps in teaching.
- Listening skills can be assessed during the question period of presentations.

Sources and Additional Resources

- *Reef Rescue* documentary on CBC Gem (Available until January 2025. Please contact info@cangeoeducation.ca after this date to access.)
- *Reef Rescue* interactive tool
- Learn about the companies involved in the creation of *Reef Rescue*, which is a Canada/France co-production produced by Merit Motion Pictures, Capa Press/Films à Cinq, and ARTE France, in association with Vulcan Productions and CBC's *The Nature of Things*.
- Watch this short Coral Reefs 101 video from *National Geographic* for a brief introduction to corals.
- Netflix's *Chasing Coral* documentary follows a team's undertaking of creating the first time-lapse camera to capture coral bleaching.
- NASA's NeMO Net: Colour in images of coral and help NASA with their classification in this app.
- Coral Morphologic: This organization brings together art and science through corals.
- Learn more about coral health and explore an interactive map of 3D reefs and 360° views of reefs with Coral Health Atlas.
- Seacology: This organization works with island communities to protect and conserve unique island ecosystems.
- Explore.org Live Cams: Looking for more live cams of reefs? Take a look through Explore's ocean options.
- Coral Assisted Evolution: Explore the research and science behind the assisted evolution of corals.

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- Learn about what the World Wildlife Fund is doing to help coral reefs.
- Visit the Allen Coral Atlas to explore maps of coral reefs and bleaching events.
- *Are Corals Animals or Plants*, article by the National Oceanic and Atmospheric Administration
- *Coral Reefs Reduce Wave Energy and Height*, infographic by The PEW Charitable Trusts
- *Basic Information about Coral Reefs*, article by the United States Environmental Protection Agency

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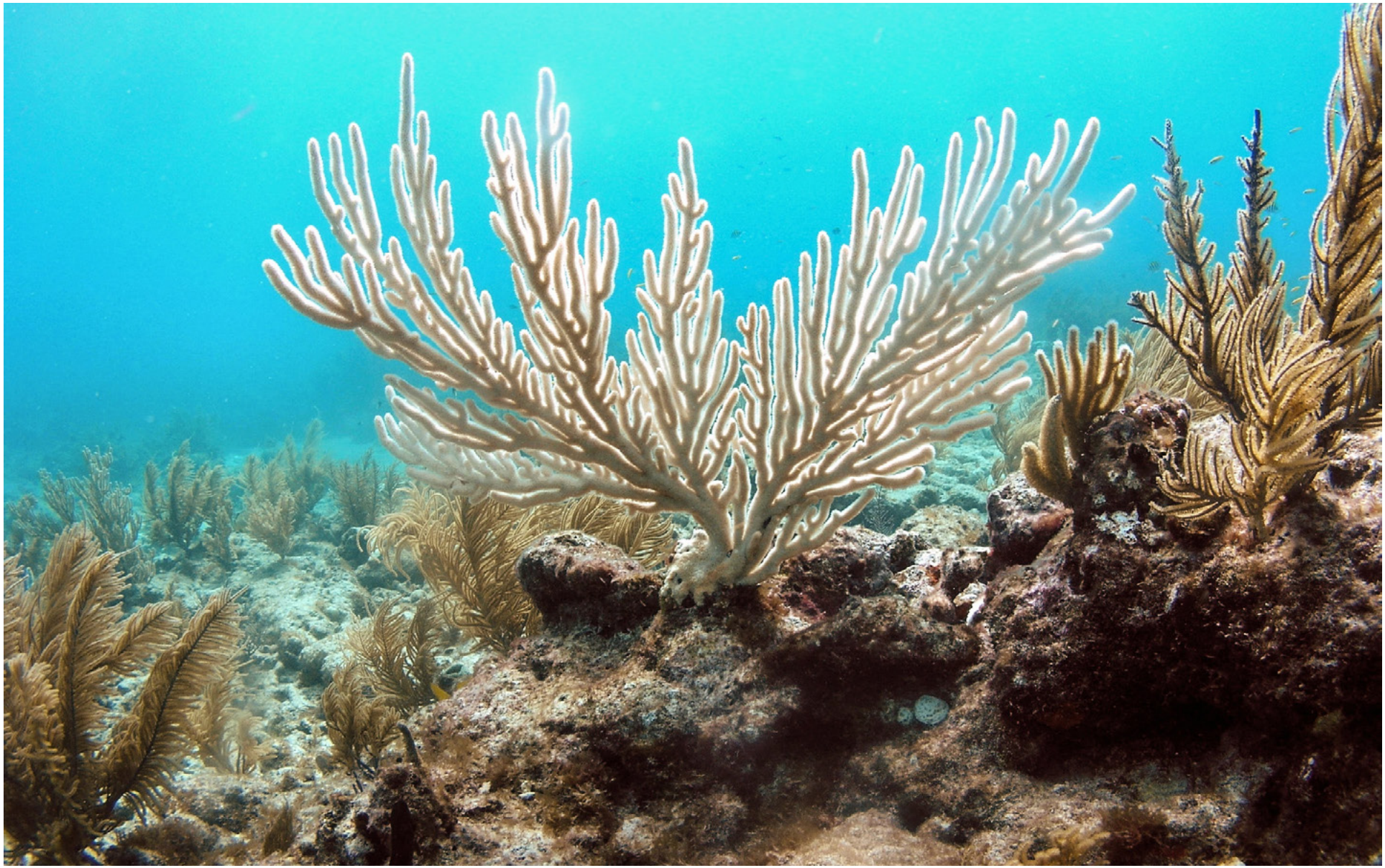

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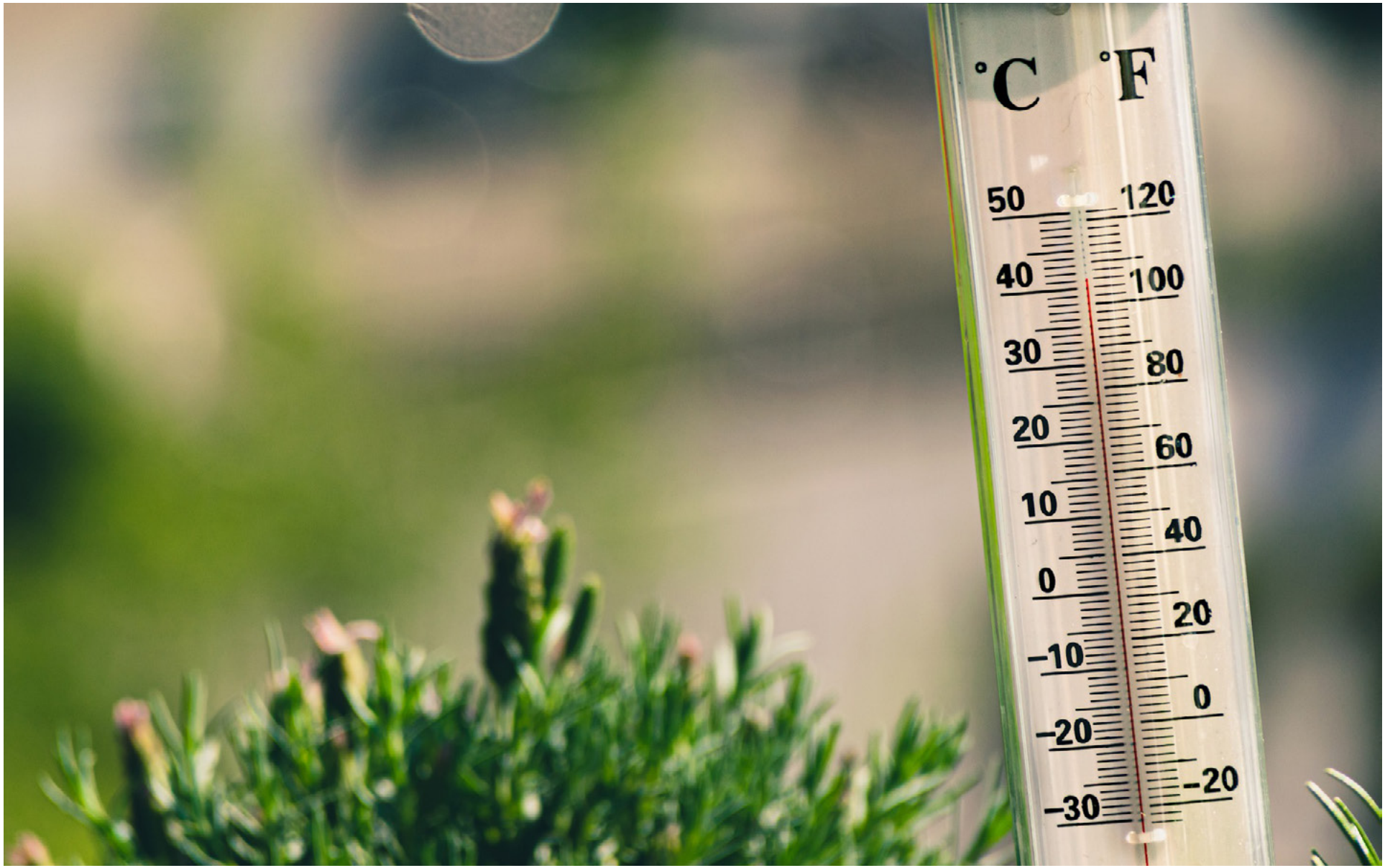

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KWL CHART

What I know	What I want to know more about	What I learned